

## SSVEO IFA List

Date:02/27/2003

STS - 33, OV - 103, Discovery ( 9 )

Time:04:20:PM

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:00:05	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-01 APU
MMACS-01	<b>GMT:</b> 327:00:29		<b>SPR</b> 33RF01	<b>UA</b>
			<b>IPR</b>	<b>PR</b> APU-3-10-0190
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** APU 1 Lubrication Oil Outlet Pressure High During Ascent (ORB)

**Summary:** DISCUSSION: Auxiliary power unit (APU) 1 lubrication (lube) oil outlet pressure (V46P0153A) rose to a higher-than-normal value during ascent. The pressure peaked at 85 psia before returning to a nominal range of 50 to 60 psia. This scenario is indicative of hydrazine in the gearbox reacting with the lube oil to form a wax (hydrazide) and a granular solid (pentaerythritol) that will partially plug the lube oil filter and cause the lube oil outlet pressure to increase. As the lube oil temperature increases to its nominal operating temperature, the wax and pentaerythritol in the filter melt and the lube oil outlet pressure returns to normal. Postflight analysis of the lube oil revealed a total filterable solids concentration of 6.41 mg/100 ml, whereas specifications require less than 5 mg/100 ml.

There are two instances prelaunch where the lube oil may have been contaminated with hydrazine: 1) During APU 1 preflight seal cavity drain purge operations, the gearbox pressure momentarily dropped below the seal cavity drain pressure. This condition was judged to be acceptable for flight (waiver WK1477). 2) Prior to preflight servicing, the seal cavity pressure was above the gearbox pressure for nearly 3 weeks (as is normal). Wax may have formed during this time that was not totally cleared during subsequent lube oil flush operations. There is no effect on APU performance if the oil filter becomes completely blocked. A bypass valve will bypass oil around the filter at a lube oil outlet pressure of about 100 psia (50-60 psid). Normal filter pressure differential is about 5 psid at normal flow rates. This condition occurred during STS-4 (Flight Problem STS-04-05). CONCLUSION: The rise in the APU 1 lube oil outlet pressure during ascent was caused by the partial blockage of the lube oil filter with wax and pentaerythritol. These contaminants were introduced into the system preflight when the lube oil was contaminated with a small amount of hydrazine. As the lube oil temperature increased during ascent, the material blocking the filter melted, allowing the lube oil outlet pressure to return to normal. CORRECTIVE\_ACTION: The lube oil system was drained and flushed, and the lube oil filter changed. This was required because of violation of the OMRSD maximum lube oil pressure limit of 75 psia. APU processing changes under consideration to preclude introduction of hydrazine into the gearbox include pressurization of the gearbox to a level above the drain system pressure as soon as possible after landing, and implementation of a hot oil flush requirement at KSC. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:12:06	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-02
EECOM-0, EECOM-02	<b>GMT:</b> 327:12:30		<b>SPR</b> 33RF02	<b>UA</b>
			<b>IPR</b>	<b>PR</b> ECL-3-10-0640
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Waste Collection System Vacuum Control Valve Failed During Use (ORB)

**Summary:** DISCUSSION: At approximately 327:12:30 G.m.t., cabin pressure began dropping at approximately 0.13 psia/min while the 14.7-psia cabin regulator was closed and the waste collection system (WCS) was in use. The cabin pressure decreased to 14.28 psia before the leak was isolated. The leak was isolated by termination of WCS operations. The 14.7-psia regulator was reopened and the cabin was repressurized.

Leakage through the WCS was verified the next day when the crew opened the WCS slide valve with the vacuum valve closed, and no fan separator flow was discerned. Therefore, the leak was caused by the commode control valve remaining in the vacuum position. The crew verified by visual inspection that the linkage from the commode control handle was not moving the control valve. An in-flight maintenance procedure was performed by the crew to allow manual movement of the vacuum ball valve, and this restored normal operation of the WCS. Postflight inspection revealed that a connecting pin in the commode control linkage had broken and caused the problem. The broken pin was a roll pin that had been mistakenly installed in the linkage where a dowel pin had been specified. Inspection also revealed that the hole into which this pin was fitted was oblong in shape, thus causing increased forces to be exerted on the pin. CONCLUSION: The WCS vacuum control valve failed to the vacuum position because an out-of-specification pin installed in the commode control linkage broke. CORRECTIVE\_ACTION: The linkage will be replaced with one having a properly drilled hole and the broken pin will be replaced with a dowel pin, bringing this unit to proper configuration. The WCS units on OV-102 and OV-104 were inspected and the presence of the correct dowel pin was verified on both units. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:23:53	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-03
None	<b>GMT:</b> 328:00:17		<b>SPR</b>	<b>UA</b>
			<b>IPR</b>	<b>PR</b> COM-3-10-147
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Text and Graphics System Jam Indications (GFE)

**Summary:** DISCUSSION: At about 328:00:17 G.m.t., the text and graphics system (TAGS) hardcopier was activated by the crew and released to ground control for

initialization by uplink command.

The initialization procedure requires that 20 pages be advance out of the hardcopier before the developer reaches full operating temperature. The purpose of this requirement is twofold. One is to ensure that all paper exposed to light when the paper roll was loaded has been removed and the second is to advance the moisture-laden outer layers of the paper roll through the developer before it becomes hot enough to boil the trapped moisture which will condense as water on adjacent paper guides. The moisture is absorbed by the paper from ambient air during the several weeks that elapse between the time that it is removed from its sealed storage bag for loading at the launch site and the time that it is used in-flight. If the paper-guide surfaces become wet, the paper tends to adhere to the surfaces and the likelihood of a developer jam increases greatly. Procedures require that no paper be advanced through the developer once a jam indication is received. During the first 20 minutes of the mission, after TAGS activation, the ADVANCE commands were omitted by the ground to advance the 20 moisture-laden sheets. Shortly after the developer reached its normal operating temperature, 10 pages were advanced through the hardcopier without incident. The crew reported that all 10 pages were black, as expected, since some exposed paper remained in the hardcopier. At about 328:01:25 G.m.t., more ADVANCE commands were issued to clear out the remaining exposed paper, the third page of which jammed in the developer. The crew performed a malfunction procedure during which they confirmed the jam in the developer and cleared it using the TAGS in-flight maintenance (IFM) tool. Additional ADVANCE commands were issued and again the third page jammed in the developer. The crew again removed the jammed page, but after doing so was unable to reset the hardcopier jam indication. A crew report that no paper was visible anywhere in the paper path led to the conclusion that one of the developer paper sensors has failed on and was falsely indicating a jam condition. The hardcopier was then powered off and not used for the remainder of the flight. Detailed postflight inspection, testing, and analysis of the hardcopier revealed no hardware failures, defects, or anomalies. An additional page was found jammed in the developer covering the paper sensor at the entry slot, which explains the persistent jam indication. The page had apparently been erroneously advanced, by ground command, into a previously jammed page and could not be removed by the crew when the final malfunction procedure was performed. Examination of the page removed from the developer and the other 16 output pages returned from the flight indicated excess moisture as the cause of the jams. No hardware failures or deficiencies were found and no repairs were required. CONCLUSION: All TAGS jam indications represented true developer paper jams that were caused by moisture condensation on the developer paper guides. The jams were the result of ground errors during the TAGS initialization procedure (20 sheets must be advanced before full operating temperature is reached). There were no false jams indications and no hardware failures or defects. CORRECTIVE\_ACTION: The TAGS hardcopier, Part No. AV14453-303, Serial No. 005, was removed, replaced, and subjected to failure analysis. No repairs were required. The procedures will be changed (Form 482 No. Multi-209) to have the crew remove the initial 20 feet of paper from the TAGS paper roll manually prior to loading and activation to eliminate dependence on a time critical ground commanded procedure and thereby avoid release of moisture into the TAGS developer. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>	
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-04	OI
	<b>GMT:</b>		<b>SPR</b>	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b>	<b>PR</b> See Text Below	

**Engineer:**

**Title:** Operational Instrumentation Failures. (ORB)

**Summary:** DISCUSSION: A. The reaction control system (RCS) F1U thruster chamber pressure (Pc) transducer failed during the flight control system (FCS) checkout. When the thruster was commanded to fire, chamber pressure increased to 4.8 psia, then slowly decayed over 6 minutes to zero. Redundancy management (RM) declared thruster F1U failed after three consecutive chamber pressure discretes of less than 29 psia. Examination of injector-temperature profiles indicated nominal propellant flow and combustion. Vehicle pitch and roll rates showed that F1U fired nominally. The most probable cause of the low Pc reading is blockage of the Pc inlet orifice.

Troubleshooting revealed contamination at the Pc orifice inlet. The contamination was removed and the subsequent Pc response test showed proper operation. The disposition is to fly the repaired transducer which now meets all requirements. This is a criticality 1R3 measurement. CAR 33RF03 is tracking this failure. This problem is closed. B. The auxiliary power unit (APU) 1 exhaust gas temperature (EGT) 1 failed during entry. The sensor was removed and replaced. Failure analysis will be tracked by CAR 33RF06. This is a criticality 3 measurement. This problem is closed. C. APU 3 EGT 2 failed during entry. The sensor was removed and replaced. Failure analysis will be tracked by CAR 33RF07. This is a criticality 3 measurement. This problem is closed. D. The right hand orbital maneuvering system (OMS) oxidizer total and aft quantities read off-scale high during the OMS-1 burn. The gage returned to nominal operation during the OMS-2 burn. The anomaly repeated for about 10 seconds during the deorbit burn. The failure is most probably in the totalizer assembly. This assembly will be removed, and replaced, if required during scheduled pod removal. No mission impact since quantity can be determined using other parameters. Normal OMRSD testing will be performed on this unit during the STS-31 flow. Analysis will be tracked on CAR 33RF10. This is a criticality 3 measurement. This problem is closed. CONCLUSION: See above. CORRECTIVE\_ACTION: See above. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: See above.

---

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 003:00:15	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-05
GNC-02	<b>GMT:</b> 330:00:39		<b>SPR</b> 33RF05	<b>UA</b>
			<b>IPR</b> 31RF-0004	<b>PR</b>

**Engineer:**

**Title:** Commander's Alpha/Mach Indicator Mach/Velocity Indication Erroneous (ORB)

**Summary:** DISCUSSION: During the on orbit dedicated display drive checkout at approximately 330:00:39 G.m.t., the crew reported that the left-hand Alpha/Mach indicator (AMI) Mach/velocity scale indicated 20,500 ft/sec during the "LOW" test. The expected value was 20,000 ft/sec. The indication on all other instruments was normal. Also, the indication for the "HI" test was normal on all instruments and the instrument functioned normally during the entry and landing phases.

This instrument (serial number 14) experienced a similar problem on STS-26 (Flight Problem Report STS-26-20). The instrument subsequently flew on STS-29 with no reported anomalies. A similar problem also occurred on OV-104 (serial number 3) during STS-30 (Flight Problem STS-30-19). In both of the previous cases, the instrument appeared to function normally during the remainder of the flight and postflight troubleshooting failed to reproduce the anomaly. Both previous problems were closed as unexplained conditions with the understanding the equipment functioned normally during operational usage and that existing V1028 ground testing would identify a failure. During the in-flight test, the general purpose computer (GPC) sends a predefined set of test values to both the left and right display driver units (DDU's), which route digital information to the alpha Mach electronics for digital-to-analog conversion and subsequent routing to the AMI. The analog signal is then used for tape positioning. No OMRSD requirements exist to perform the in-flight test, and no in-flight tolerances are defined. The ground test is required each flow and is to be repeated if the time interval since the last test exceeds 3 months. Postflight troubleshooting has not reproduced the anomaly and analysis has failed to identify a cause. Analysis is continuing at Rockwell in an effort to understand this phenomenon. A possible result of the analysis may be the identification of in-flight tolerances. **CONCLUSION:** The cause of the erroneous AMI indications remains unknown. **CORRECTIVE\_ACTION:** No corrective action is defined at this time. Subsequent corrective action, if required, will be documented on CAR 33RF05. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** None. Acceptability for flight is based on the following: (1) The anomaly appears to be unique to the in-flight test mode only; (2) No evidence of erroneous indications exists during operational usage or ground testing; (3) A hard failure of the DDU or the instrument will be annunciated to the crew, and backup instruments are available.

---

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 000:23:34	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-06
INCO-03	<b>GMT:</b> 327:23:57		<b>SPR</b> 33RF05	<b>UA</b>
			<b>IPR</b> 31RV-0003	<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** The Ku-Band System Failed Self Tests (ORB)

**Summary:** DISCUSSION: The Ku-Band system failed self-test twice during system activation and again during the self-test that was performed prior to stowing the deployed assembly (DA). At approximately 327:23:57:30 G.m.t., the first self-test failed because the transmitter did not have adequate time to warm-up (requires 4 minutes) prior to the self-test. Power was erroneously removed after 2 minutes. The procedures were reviewed and found to be adequate.

The second self-test failure occurred at about 328:00:06:00 G.m.t., and is unique in that the cause for this occurrence is not evident in the data from the parameters that are used to determine the subsystem performance during the self-test. The third self-test failure occurred at about 330:06:03:00 G.m.t., and resulted from an idiosyncrasy during the active mode test phase. The radio frequency pulse is changed from 4.15 microseconds to 0.122 microseconds at the transition from detection to track. At this transition, the track flag is sampled and the flag may be high or low. If the track flag is low then a failure is reported. This failure is a known condition and does not affect the performance of the Ku-Band system. The self-test failures did not affect the performance of the Ku-Band system. The system performed nominally throughout the mission. The second self-test failure that occurred in-flight could not be repeated during postflight troubleshooting. However, the DA was removed and replaced because of an IPR condition documented on the lower lock mechanism. Six self-tests have been successfully completed on the Ku-Band subsystem now installed on OV-103 for

STS-31. Postflight system analysis and data review have not determined the cause for the second self test failure which occurred in-flight. This analysis effort will continue as part of the failure analysis for CAR 33RF05. **CONCLUSION:** The cause for the first self-test failure was an inadequate transmitter warm-up period prior to the self test. The cause for the second self-test failure is unknown. The cause of the third self-test failure is a known idiosyncrasy during the active mode test phase. **CORRECTIVE\_ACTION:** The DA has been removed, replaced, and retests indicate nominal Ku-band system performance. System and data analysis are continuing and the results of this activity will be tracked via CAR 33RF05. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** None expected

---

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-07
None	<b>GMT:</b>		<b>SPR</b> 33RF08	<b>UA</b>
			<b>IPR</b>	<b>PR</b> HYD-3-10-0322 and -
				0323
				<b>Engineer:</b>

**Title:** Hydraulic System 1 and 2 Accumulator Pressure Locked Up Low (ORB)

**Summary:** DISCUSSION: After auxiliary power unit (APU) shutdown following ascent, the hydraulic systems 1 and 2 accumulator lock-up pressures of 2400 and 2340 psia, respectively, were below specification. During STS-26 and -29, system 1 and 2 priority valves also reseated below the specification value. The specification requires a 2600-psid minimum pressure referenced to reservoir pressure. Lock-up pressures have been repeatable during the last three flights of OV-103 and have shown no sign of degradation. Furthermore, during ground testing after STS-29 (Chit J-2956), two out of the six lock-up pressures were below the specification value. No immediate system concern exists and the priority valves are consider marginally low but acceptable (ref. CAR 29RF26). These valves had never flown prior to STS-26.

Each hydraulic system contains a priority valve that is used to control the accumulator pressure and assure a positive head pressure at the main pump inlet during APU start up. The accumulator lock-up pressure is dependent on the reseat pressure of the priority valve. Acceptance test procedure (ATP) data indicate that these valve-reseat set points are close to the minimum requirement of 2600 psig. In addition, the ATP pressure measurement is taken from the liquid side of the accumulator, which is not representative of the Orbiter. Only the gas side of the accumulator is instrumented on the Orbiter. Currently no data exist that correlate the fluid pressure to gas pressure response. However, it is known that accumulator gas pressure is affected by adiabatic expansion and accumulator piston stiction at the time of APU shutdown. Both can cause the gas pressure to appear to be low. This is evident by the rise in accumulator pressure seen over time after shutdown, with no corresponding temperature rise. **CONCLUSION:** The hydraulic systems 1 and 2 bootstrap accumulator pressures locked up below the specification value after APU shutdown because of the minimum set point of the priority valves and accumulator piston stiction. **CORRECTIVE\_ACTION:** The two priority valves will be replaced and the crack pressure requirement will be changed from 3000-psig maximum to a range of 2900-3000 psig. This change will allow reseat to occur between 2750-2850 psig. The 2600-psid operational limit will be kept as the pass/fail criteria, thus allowing for a margin against the inherent system inaccuracies. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	<b>MET:</b> 001:12:21	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-08	PRSD
None	<b>GMT:</b> 328:12:45		<b>SPR</b> 33RF09	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b> None.	<b>PR</b>	<b>Engineer:</b>

**Title:** PRSD O2 Tank 1 Check Valve Sticky (ORB)

**Summary:** DISCUSSION: The power reactant storage and distribution (PRSD) O2 tank 1 check valve failed to operate properly on two occasions (approximately 328:12:45 and 330:09:50 G.m.t.). On both of these occasions, the PRSD O2 system was configured so that tanks 1 and 3 were manifolded together, tank 3 heaters were on and tank 1 heaters were off. In this configuration, the tank 3 heaters cycle to maintain tank 3 pressure between 840 and 875 psia; therefore, the common manifold pressure tracks the tank 3 pressure. Normally with the tank 1 heaters off, tank 1 pressure climbs slowly due to environmental heat leak until its pressure is 3-5 psia above the manifold pressure, which coincides with the bottom of a tank 3 pressure cycle. At this time, the tank 1 check valve opens and allows flow from the tank into the manifold until manifold pressure exceeds tank pressure and the check valve closes preventing backflow into the tank.

On both occasions when the check valve stuck, a 20-psi differential pressure was required to open it. Subsequently, nominal operation resumed with the valve cracking at 3-5 psid for the remainder of the time that the system was in this configuration. Two possible explanations for the anomaly are contamination and high closing force. The phenomenon was probably caused by contamination since the valve design has a very narrow gap (0.001 inch) between the moving poppet and the housing that is contamination sensitive. At approximately 327:12:25 G.m.t. this check valve experienced a large closing force (180 psid) after a high O2 flow to the environmental control system was stopped. The high O2 flow was caused by a leak in the waste collection system. Stopping the high flow caused cold, dense cryogenic oxygen to be trapped in the manifold where environmental heat leak caused rapid pressurization until the relief valve opened. **CONCLUSION:** The PRSD O2 tank 1 check valve exhibited a transient sticking behavior when the tank was not in use, and this behavior was caused by either contamination or because the valve experienced a high closing force. **CORRECTIVE\_ACTION:** The PRSDS O2 tank 1 check valve will be flown as-is. Since this phenomenon was transient with the cracking pressure returning to the nominal 3-5 psid, and since the phenomenon occurred only when tank 1 was not in use and never elevated tank 1 pressures out of the nominal tank pressure range, this phenomenon represented no impact to crew safety or mission success. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-09	C&T
None	<b>GMT:</b>		<b>SPR</b> 33RF11	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b> 31RV-0006	<b>PR</b> COM-3-10-0148	<b>Engineer:</b>

**Title:** Microwave Scanning Beam Landing System (MSBLS) 3 BITE Annunciation (ORB)

**Summary:** DISCUSSION: The microwave scanning beam landing system (MSBLS) 3 experienced several crystal current BITE flags during entry. MSBLS was not used on this flight because runway EDW 04 was used for landing, therefore no in-flight performance data was available. Postflight troubleshooting failed to reproduce the anomaly. This symptom has been observed before as a result of a gradual degradation in the transmitter/receiver (T/R) limiter portion of the MSBLS decoder assembly. The decoder assembly was removed, replaced, and sent to the vendor. Testing at the vendor has failed to reproduce the anomaly.

CONCLUSION: The cause of this anomaly was most probably a gradual degradation in the MSBLS decoder assembly. This is not a hard failure and the integrity of the data output is not affected. Presence of the crystal current BITE flag was most probably an early indication of an end-of-life condition for the T/R limiter in this particular MSBLS decoder assembly. **CORRECTIVE\_ACTION:** Corrective action will be documented on CAR 33RF11. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** None.

---

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>		<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> Postlanding	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-10	EPDC
None	<b>GMT:</b> Postlanding		<b>SPR</b>	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b>	<b>PR</b> PYR-3-09-0117	<b>Engineer:</b>

**Title:** Forward External Tank/Orbiter Attachment System A and System B Pyrotechnic Connectors Damaged. (ORB)

**Summary:** DISCUSSION: During the postflight inspection of the OV-103 forward External Tank (ET) attachment mechanism, pyrotechnic connector 20V77W11J13 (System A/Post Side, P/N V070-772927-001) had a broken strain relief tang and connector 20V77W12J12 (System B/Starboard Side, P/N V070-772928-001) had a loose backshell because of a broken set screw.

Background: During the ET forward attachment mechanism stop bolt inspection of OV-102 at KSC following STS-28, the pyrotechnic harness wire restraint was found installed upside down, thus creating the potential for the improperly installed wire restraint to contact the centering mechanism during ground or flight operations and result in a potential loss of the pyrotechnic function. As a result, after the STS-34 (OV-104 flight 5) Flight Readiness Review and prior to STS-33 (OV-103 flight 9), a design analysis was performed and laboratory tests were conducted to determine the rotational requirements and capacities in this area. The results of the Orbiter/ET forward attachment separation bolt rotation analysis (taking into consideration tank shrinkage, manufacturing tolerances and effects of Space Shuttle main engine firing) showed that under nominal conditions 10 deg 27 min of rotational movement would be expected with a maximum rotation of 11 deg 42 min. Results of laboratory tests conducted to verify actual rotational capability show: a. 14 deg without connectors installed. b. 11 deg 30 min with connectors properly installed. c. <1 deg with aft facing connector strain relief. OV-102 was tested for STS-32 and a rotational movement of 11 deg 53 min was demonstrated with the connectors installed. Clearances were computed for all possible combinations of rotational and manufacturing conditions: Clearance, inch Manufacturing 10 deg 27 min 11 deg 42 min Condition



rotation rotation Best \_\_\_\_\_ +0.287 \_\_\_\_\_ +0.177 \_\_\_\_\_  
 Nominal \_\_\_\_\_ +0.138 \_\_\_\_\_ +0.028 \_\_\_\_\_ Worst \_\_\_\_\_ -0.021 \_\_\_\_\_ -  
 0.130 \_\_\_\_\_ L&T Hardware \_\_\_\_\_ +0.10 \_\_\_\_\_ -0.02 \_\_\_\_\_ OV-102  
 Hardware/ \_\_\_\_\_ 11 deg 53

min \_\_\_\_\_ +0.379 \_\_\_\_\_ +0.053 \_\_\_\_\_ Under worst case conditions with maximum separation bolt rotation and maximum cumulative manufacturing tolerances, a 0.130-inch interference would result. The stress assessment indicated that worst case separation bolt interference with the strain relief backshell will result in a benign structural failure that will not affect the connector function. Post STS-28 Resolution: The pyrotechnic wire harnesses are replaced each flight. A modified wire harness is being considered by the Orbiter Project to eliminate potential interference. For STS-33 (OV-103) a functional verification in the Orbiter Processing Facility per Orbiter Maintenance Instruction V5012 (approximately 13-degree rotation demonstrated with the connectors installed) eliminated the possibility of an aft-facing strain relief and the post-tanking pyrotechnic ignition control resistance test at T-4 hours will provided electrical verification of the pyrotechnic circuits. Post STS-33 Findings: After flight 9 of OV-103, the connectors were found to be improperly aligned 30 degrees from the normal position. The connectors on OV-102 were verified to be in the correct position for STS-32. Engineering review and tests verified that when the ET mechanism housing is moved to the extreme forward position, a hard interference exists between the forward ET mechanism and connector assemblies. The greatest potential for this type of damage occurs during the ET/Orbiter mating operations. The connectors can not be visually verified once the Orbiter is mated to the ET. Damage can still occur on the pad because the shear bolt shaft is accessible and can be manually rotated. A design change was approved on 1/09/90 and is currently effective for: OV-102 Flight 12 STS-42 OV-103 Flight 12 STS-39 OV-104 Flight 8 STS-41 OV-105 in-line The harness installation and the alignment of the connector strain reliefs should be verified prior to each flight until the existing connector is replaced with a connector assembly that eliminates the potential for interference by reducing the depth of intrusion into the ET separation area. CONCLUSION: The STS-33 connectors were improperly aligned resulting in separation bolt rotation interference. CORRECTIVE\_ACTION: A more detailed inspection of the area is performed just prior to Orbiter/ET mate. A design change has been approved that will eliminate the potential for interference with the ET separation mechanism. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: Continue to perform detailed inspections of the area after each harness installation prior to each flight until the design change is implemented. A more detailed inspection of the area is performed just prior to Orbiter/ET mate. A design change has been approved that will eliminate the potential for interference with the ET separation mechanism.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> Postlanding	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-11 TPS
None	<b>GMT:</b> Postlanding		<b>SPR</b> 33RF13	<b>UA</b>
			<b>IPR</b> 31RV0005	<b>PR</b>
				<b>Engineer:</b>

**Title:** -Y Star Tracker Blanket Detached. (ORB)

**Summary:** DISCUSSION: During postflight operation of the star tracker doors, it was noted that the door blankets had come loose and were interfering with the bright

object sensor.

Prior to STS-34, a design modification was made to attempt to preclude any interference problems. The fastener installation permitted the blanket to sag into the path of the bright object sensor when the doors were opened. A thermal analysis (IL SAS-TA-TPS-89-326/November 16, 1989) determined the star tracker area remains within required temperature limits without the door blankets in place. CONCLUSION: The fastener installation permitted the blanket to "sag" into the path of the bright object sensor when the doors were operated. CORRECTIVE\_ACTION: The deletion/removal of the thermal control system (TCS) blankets from the -Y and -Z star tracker door

to prevent a potential door jam (Ref. MCR 16260) on all three vehicles has been authorized by: PRCBD DATE APPROVED EFFECTIVITY  
S61532A 12/04/89 OV-102 Flight 09 S11531N 12/12/89 OV-103 Flight 10 S11536U 12/12/89 OV-104 Flight 06 EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>	
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-12	GNC
GNC-01	<b>GMT:</b>		<b>SPR</b> 33RF14	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b>	<b>PR</b> STR 3-10-452	<b>Engineer:</b>

**Title:** The +X COAS Line-of-Sight Shifted by As Much As 0.272 degree between COAS Calibrations. (ORB)

**Summary:** DISCUSSION: In conjunction with development test objective (DTO) 790, Inertial Measurement Unit (IMU) Reference Recovery Techniques, the +X crew optical alignment sight (COAS) was calibrated on flight days 2, 3, and 4. These calibrations revealed the line-of-sight of the +X COAS had shifted by as much as 0.272 degree. The procedure requirement is for a line-of-sight difference of less than 0.12 degree. Although the COAS was not calibrated immediately following an IMU alignment during any of the DTO data takes (standard procedure generally is for COAS calibrations to follow and IMU alignment to ensure an accurate COAS line-of-sight), it has been determined that IMU drift does not account for the majority of variations in the +X COAS line-of-sight.

This anomaly is similar to, but less in magnitude than the +X COAS anomaly experienced during STS-29 (reference Flight Problem STS-29-15). As a result of troubleshooting following the STS-29 anomaly, all three guide pin holes on panel O1 were found to be smaller than specification (0.2525 +/-0.0005 inch diameter). Only one hold was reamed to specification prior to STS-33. CONCLUSION: The +X COAS line-of-sight discrepancies are attributed to an interference fit between the +X COAS adapter plate and panel O1, which is caused by two of the three guide pin holes being too small. The interference fit would prevent the adapter plate from fitting flush against panel O1, manifesting itself as +X COAS line-of-sight variations. CORRECTIVE\_ACTION: The two undersized guide pin holes will be reamed to meet specification requirements (reference chit J3174R1). EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-13
EECOM-03	<b>GMT:</b>		<b>SPR</b> 33RF15	<b>UA</b>
			<b>IPR</b> None.	<b>PR</b>
				<b>Engineer:</b>

**Title:** FES Primary Controller B Outlet Temperature Oscillation (ORB)

**Summary:** DISCUSSION: During entry preparations, the flash evaporator system (FES) primary B controller was switched from the ON to the GPC position and this caused a FES re-start. The freon outlet temperature oscillated during startup and kept the freon outlet temperature above the control band long enough to cause an automatic shutdown of the FES at approximately 331:19:45 G.m.t. The crew recycled the primary B controller and the FES was successfully restarted. The FES performed nominally for the remainder of the mission.

This phenomenon was first experienced on the previous flight of OV-103 (Problem Report STS-29-14). The oscillation occurred only when a FES controller was using its midpoint sensor in the control logic. This problem was caused by a redesigned midpoint sensor block which was installed only on OV-103. The redesigned block has a smaller freon flow path, that causes the block to have a slower thermal-response time than other units and results in outlet temperature oscillations. After STS-29, the temperature sensors in the block were repacked in thermal grease at a higher pressure to improve the thermal response time to the sensor. The thermal response of the midpoint sensor block was improved since the oscillations seen on STS-33 were fewer and of smaller magnitude. CONCLUSION: The FES primary B controller temperature oscillations were caused by a lag in the thermal response of the modified OV-103 midpoint sensor block. CORRECTIVE\_ACTION: Further improvements in the thermal response time of the midpoint sensor block are not possible without removal and replacement of the OV-103 block. The OV-103 unit will be flown as-is. Crew procedures changes are in work to minimize nuisance FES shutdowns including those caused by this oscillation phenomenon on OV-103. Even if the FES shuts down because of the oscillations, it can be easily restarted on any of the primary or secondary controllers. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b> BFCE-023-F-006	<b>IFA</b> STS-33-V-14
EECOM-03	<b>GMT:</b>		<b>SPR</b>	<b>UA</b>
			<b>IPR</b> None.	<b>PR</b>
				<b>Engineer:</b>

**Title:** a) Galley Rehydration Station Failed to Dispense Hot or Cold Waterb) Galley Rehydration Station Slide Sticky (GFE)

**Summary:** DISCUSSION: a) At 330:08:36 G.m.t., the crew reported that the galley rehydration station would not dispense either hot or cold water. Prior to the failure, the

galley over fans were switched on. The crew then executed a malfunction procedure and were able to regain the use of the rehydration station through resetting the galley control electronics. The rehydration station performed nominally for the remainder of the flight.

Postflight troubleshooting of the galley electronics did not reproduce the failure to dispense. However, diodes which prevent current spikes from reaching the microprocessor appeared damaged. Current spikes from valves could cause a microprocessor lockup if these diodes fail. The coating on these diodes was inadvertently removed during a galley modification prior to reflight when some of the galley terminal boards were soaked in solvent to remove conformal coating. If the faulty diodes were not the cause of the problem, the only other cause would be electromagnetic interference (EMI) between the oven fans and the galley electronics. Troubleshooting efforts on this flight unit and the galley trainer showed that when the oven fans were switched on during a dispense cycle, microprocessor glitches could occur. Although the exact place at which the fan ac noise enters the microprocessor could not be pinpointed, the shielding throughout the wiring harness is known to be inadequate. The galley currently flies under the EMI waiver. b) During the crew debriefing, the crew mentioned that the slide on the rehydration station was sticking. The crew remedied the problem by lubricating the slide with "Chapstick". Troubleshooting personnel found no difficulty moving the slide once the rods had been cleaned and lubricated. No interference or contamination were found that would have made the slide difficult to move. CONCLUSION: a) The rehydration station failure to dispense was caused either by a power spike introduced to the galley microprocessor through one of the diodes having a faulty coating or by electromagnetic interference between the oven and the galley electronics. b) The cause of difficulty in moving the drink container slide is unknown. The difficulty can be remedied by lubrication of the slide. CORRECTIVE\_ACTION: a) The faulty diodes were removed and replaced. The soaking process which damaged these diodes was unique to this galley unit, therefore none of the other galley units should experience this problem. The upcoming repackaging of the galley, effective with STS-43, will eliminate EMI. Until then, the crews will be instructed not to turn the over fans on during a dispense cycle. b) The slide has been lubricated with Krytox lubricant. EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: None.

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b> 001:10:31:30.902	Problem	<b>FIAR</b> BFCE-210-F-005	<b>IFA</b> STS-33-V-15
MMACS-03	<b>GMT:</b> 328:10:55:00.000		<b>SPR</b>	<b>UA</b>
			<b>IPR</b> None.	<b>PR</b>
				<b>Manager:</b>
				<b>Engineer:</b>

**Title:** Arriflex 16mm Camera Inoperative (GFE)

**Summary:** DISCUSSION: At approximately 328:10:55 G.m.t., the crew reported that the 16mm Arriflex motion picture camera failed to operate when using the operate lever. The camera appeared to operate nominally using the test button. The crew performed an in-flight maintenance (IFM) procedure that provided power to the camera from the IFM breakout box. The camera operated intermittently in this mode for the remainder of the flight.

Postflight troubleshooting at JSC showed that the fuse in one of the camera battery packs had blown, but the intermittent operation problem could not be duplicated. However, several minor anomalies were seen during troubleshooting that indicated malfunctions in the camera electronics. **CONCLUSION:** The initial loss of the camera function was caused by the blown battery pack fuse. The cause of the intermittent operation cannot be definitely determined, but is thought to be related to the malfunctions in the camera electronics which were noted during troubleshooting. **CORRECTIVE\_ACTION:** The camera has been returned to the vendor for repair of the electronics. **EFFECTS\_ON\_SUBSEQUENT\_MISSIONS:** If the problem should recur, loss of the camera operation will not impact crew safety or mission success.

---

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>	<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-16
None	<b>GMT:</b>		<b>SPR</b>	<b>UA</b>
			<b>IPR</b>	<b>PR</b> APU-3-10-0193, -0194
				<b>Engineer:</b>

**Title:** APU's 1 and 3 Fuel Bypass Line Heater System A Temperatures Erratic (ORB)<br><b><font color=Blue><u>Summary:</U></font></b><b>DISCUSSION:  
The fuel bypass line heater system A temperatures for auxiliary power units (APU's) 1 and 3 (V45T0128A and V46T0328A, respectively) displayed erratic heater cycling during on-orbit operation. The APU 1 A heater showed anomalous cycling behavior for approximately 6 hours on flight day 2 and operated nominally at all other times. The A heater on APU 3 displayed approximately 6 hours of erratic cycling on flight day 2 and 4 hours on flight day 3. The operation was nominal at all other times. The B heater system on both APU's displayed nominal behavior.

A similar heater cycle was observed on the B heater system of APU 2 on OV-104 during STS-34 (Flight Problem STS-34-10). A postflight failure analysis revealed that the associated heater thermostat had experienced high vibration levels which resulted in excessive wear on the bimetallic disk component. The combination of conductive wear products contaminating the electrical contacts and the effects of a worn bimetallic disk produced the erratic heater cycling. This thermostat is mounted on the APU reference line. Vibration instrumentation placed on the reference line on the test APU's line shown that the line may experience vibrations with g-load amplitudes exceeding the thermostat design levels. The APU fuel bypass line heater A and B thermostats are both mounted on the APU reference line. Because erratic behavior of the A heaters indicated that the STS-33 thermostats may have experienced high vibrations, it was established that both A and B thermostats on APU's 1 and 3 would be replaced. However, after determining the APU 3 was scheduled for removal after its next flight (STS-31), and the APU 3 thermostats were difficult to reach and their changeout entailed some risk of damaging the Orbiter, it was decided that the APU 3 thermostats would remain for one more flight. Both the A and B thermostats on APU 1 were removed and replaced. Postflight analysis of the two thermostats confirmed the existence of worn bimetallic disks due to vibration. It was concluded that the thermostats electrical contacts were temporarily contaminated by conductive wear products which resulted in changes to the heater setpoints. When the contamination subsequently cleared, the setpoints returned to normal. **CONCLUSION:** The erratic cycling of the heaters was caused by wearing of the bimetallic disk element of the controlling thermostats due to high-amplitude vibration of the thermostats. The conductive wear products temporarily contaminated the electrical contacts and resulting in changes to the thermostat setpoints. When the contamination cleared, the setpoints returned to control. **CORRECTIVE\_ACTION:** The thermostats associated with the APU 1 A and B fuel bypass line heaters were removed and replaced. APU 3 and its thermostats will be replaced after the next flight of OV-103. The addition of a

vibration dampening clamp to the reference line of each APU is in work. Workarounds for a potential thermostat failure that may occur on future missions before the dampening clamp can be added include switching to the back-up heater system, orienting the vehicle to maintain proper temperatures, and/or manual control of the heaters.

EFFECTS\_ON\_SUBSEQUENT\_MISSIONS: Erratic cycling may occur on the APU 3 heaters. This should not impact the mission

<u>Tracking No</u>	<u>Time</u>	<u>Classification</u>	<u>Documentation</u>		<u>Subsystem</u>
MER - 0	<b>MET:</b>	Problem	<b>FIAR</b>	<b>IFA</b> STS-33-V-17	HYD
None	<b>GMT:</b>		<b>SPR</b> None	<b>UA</b>	<b>Manager:</b>
			<b>IPR</b> None	<b>PR</b>	<b>Engineer:</b>
<b>Title:</b> Water Spray Boiler GN2 Tank Pressure Decay (ORB)					
<b>Summary:</b> DISCUSSION: The system 2 water spray boiler (WSB) leaked gaseous nitrogen (GN2) during on-orbit operations. The GN2 tank pressure decayed approximately 0.36 psi/hour, and the allowable leak rate is 0.3 psi/hour.					
The pressure decay did not affect the WSB performance. The nitrogen tank is serviced to 2500 psi prior to each flight. This amount of nitrogen is more than adequate for WSB operation even with the pressure decay experienced. The worst-case planned WSB usage for an abort once around (AOA) requires approximately 1100 psi. GN2 pressure is monitored during the flight and should a large nitrogen leak occur, the affected WSB would be lost. This would in turn, result in the possible loss of the associated auxiliary power unit (APU) because of the loss of cooling capability. To protect against the loss of the corresponding APU, the APU would not be started (Flight Rule 10-23) until terminal area energy management (TAEM). CONCLUSION: Possible leak paths that could account for the decay are external GN2 tank leakage through a line fitting, the fill/quick disconnect, or through the GN2 shutoff valve. CORRECTIVE_ACTION: The GN2 circuit will be thoroughly tested during ground turnaround checkout per OMRSD V58AK0.000, Fluid System Leakage Verification Procedure. If the marginal out-of-specification leakage cannot be repeated or the source of the leak pinpointed, the system will be flown as is, since more than an adequate margin of GN2 exists for WSB operation.					
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.					